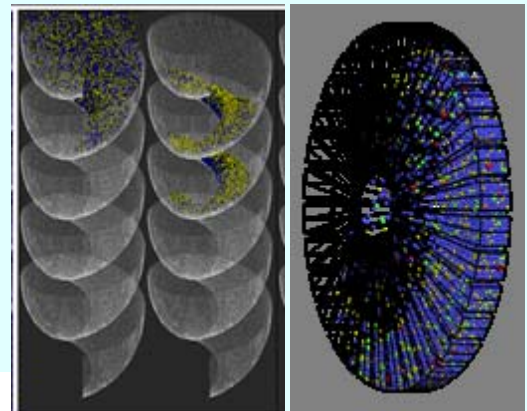
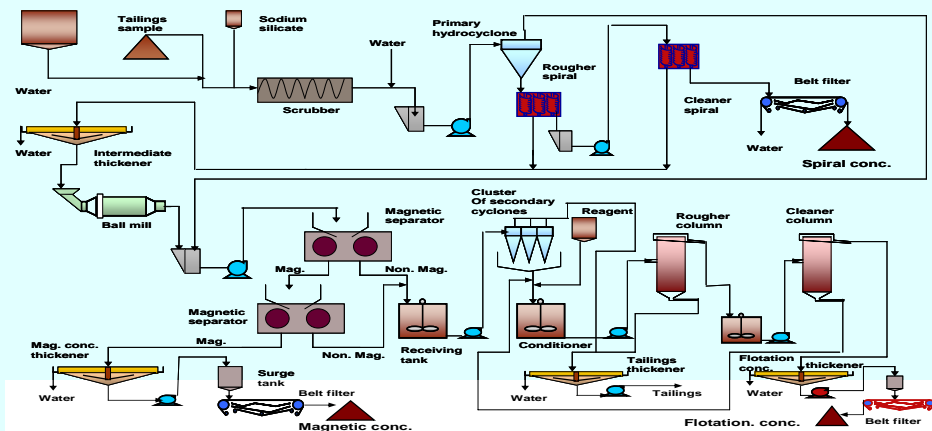
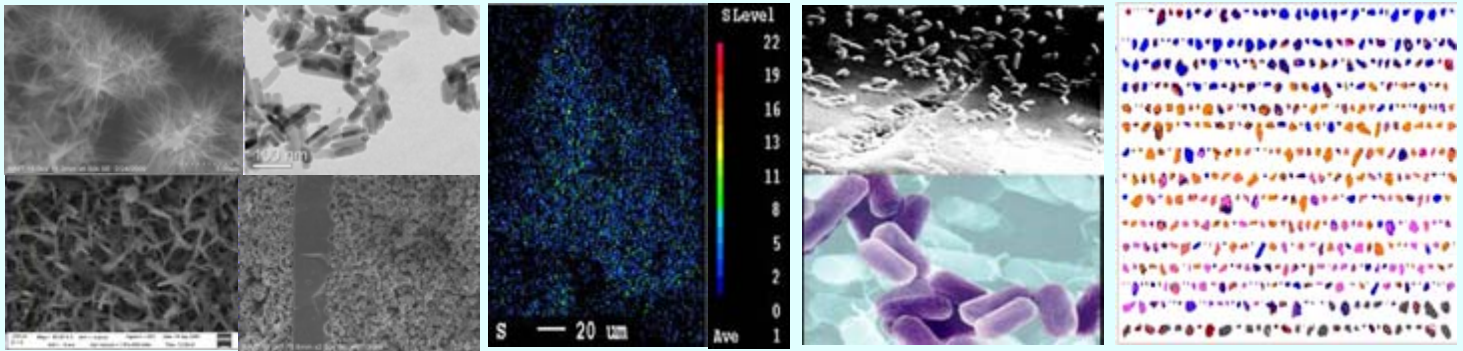
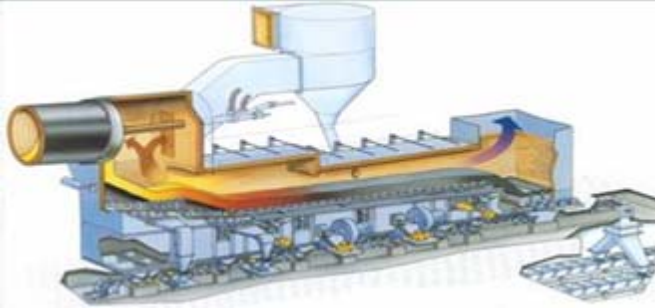


# Post Graduate Research Programme In Materials Resource Engineering

## PROSPECTUS - 2010



immt

**Institute of Minerals & Materials Technology**  
*(Council of Scientific & Industrial Research)*

Bhubaneswar – 751013

## **Post Graduate Research Programme In Materials Resource Engineering**

Innovations in mineral and materials engineering have been the engine of growth for human civilization since time immemorial. This has become all the more important now in view of the rapidly increasing demand for different types of bulk materials vis-à-vis the sharp depletion in availability of quality resources required for their preparation and the increasing environmental constraints associated with such growth. The aim of this course is to develop the next generation of researchers equipped with necessary skill and knowledge to make continual innovations for meeting these challenges through development of novel processes, products, equipments and applications.

The course aims to impart advanced knowledge in mineral engineering and process metallurgy with underpinning scientific concepts, computational methods and process engineering principles. IMMT being a research institute, the students would naturally be exposed to solving real life industrial problems. Starting from various minerals, intermediates, byproducts and waste, the scope covers processing and value addition of these primary or secondary resources through extraction, purification, modification and recycling, to produce bulk materials of desired quality and property.

The two year post graduate research program in “Materials Resource Engineering” is designed with the philosophy of promoting quality education in trans-disciplinary areas and creating a centre of learning to develop research and industry ready manpower who can emerge as future technology leaders.

### **Eligibility**

A Bachelor’s Degree in Engineering or Technology in Metallurgical, Materials Engineering, Material Science, Chemical, Mechanical, Mining, Mineral or Ceramic Engineering shall be considered as the basic pre-requisite qualification for admission to this programme at IMMT Bhubaneswar. Other conditions and eligibility criteria in respect of age and academic score shall be as per CSIR guidelines. Please see the URL <http://www.csir.res.in> for further information and submission of online application.

**Duration**

Two year full time residential programme at IMMT Bhubaneswar campus.

**Number of Seats**

10 seats for the '2010 -12' batch

**Fellowship**

The selected candidates shall be provided fellowship of Rs. 25,000/- per month. The candidates have to pay semester fees @ Rs. 24,000/- per semester in addition to hostel rent and other fees as mentioned in the PGRPE brochure.

**Submission of Fees**

Total amount of Rs. 34,000/- needs to be deposited at the time of admission. Subsequently, only the semester fees of Rs. 24,000/- needs to be deposited before the start of every semester.

For NEFT bank transfer, please transfer the amount to the bank account number 30267734773 of IMMT Bhubaneswar, at SBI, RRL Branch, Bhubaneswar-751013 (IFSC code SBIN0007499) with appropriate narration statement.

In case of Demand Draft, please get it issued in favour of "Director, IMMT" payable at Bhubaneswar and post it by speed post or registered letter to "Director, IMMT, Bhubaneswar - 751013" with your name written in pencil on the reverse side of the demand draft.

**Application & Selection Process**

The application and selection process shall be as per CSIR guidelines. The candidate is requested to see the details at <http://www.csir.res.in>.

**Placement**

The students will have exposure to hands-on research & industry interaction to acquire the right knowledge, skill and expertise to fulfill the R&D needs of minerals and materials industry. They will have ample scope to join this rapidly growing industrial sector in professionally challenging positions. In addition, students completing the programme with distinction may be considered for absorption within CSIR as regular scientists in PB3 (scale of Rs. 15600 - 39100 with grade pay of Rs. 6600).

## Programme Description

The programme consists of two semesters of course work, one summer term of basic training on various research related skills, and two semesters of project-cum-thesis work.

### Semester-wise Course Scheme

#### 1<sup>st</sup> SEMESTER

S.N.	Course	Hours/ Week		Credits
		Lecture	Practical/ Tutorial	
1.	Technologies for mineral resource utilization	5	3	5
2.	Materials characterization technique	3	6	4
3.	Science for engineers	3	0	3
4.	Process control & instrumentation	3	3	3
			Total	15

#### 2<sup>nd</sup> SEMESTER

S.N.	Course	Hours/ Week		Credits
		Lecture	Practical/ Tutorial	
1.	Advanced extraction methods	3	3	4
2.	Process design & simulation	3	3	4
3.	Fundamentals of engineering analysis	3	0	3
4.	Recycling of material resources	3	3	3
5.	Energy & environment	3	3	3
			Total	17

#### SUMMER TERM

1. Research Methodology (Compulsory)
2. Technical Writing and Communication (Compulsory)

<b>3<sup>rd</sup> SEMESTER</b>	<b>Credits</b>
1. Industrial interaction and research project planning	4
2. Seminar participation and presentation	4
4. Thesis work	8
<b>4<sup>th</sup> SEMESTER</b>	
1. Thesis work	16
Report preparation	
Seminar participation and presentation	
<b>TOTAL CREDIT</b>	<b>64</b>

## **Brief Course Outline**

### **1. Technologies for Mineral Resource Utilization**

Particulate technology, particle size distribution, sizing methodology, size-reduction and classification processes; Particulates in suspension, stability, rheology and settling; Solid-liquid separation methods; Physics, chemistry, and engineering design applied to gravity, magnetic, electrostatic, and froth flotation processes

### **2. Process Design & Simulation**

Preliminary resource evaluation methods; Identification and development of process flow sheet; Elementary evaluation of plant performance; Spread-sheet development for plant data analysis; Introduction to simulation environment using MODSIM, simulator structure, numerical analysis of simulation, sequential method of simulation, practical application of plant simulation; Materials and energy balance, mass balance smoothing, data reconciliation in terms of grade and recovery, analysis of complex flowsheet for mass balancing, examples of material balance smoothing; Application of modeling and residence time distribution concepts for plant data interpretation; Parameter estimation: linear regression, one, two, and multi-linear regression; models nonlinear in parameters; Case studies of typical process plant design and operation.

### **3. Materials Characterization Technique**

Size and surface area analysis; Interaction of X-rays with matter, diffraction techniques and applications; Optical principles of microscopy; electron diffraction, imaging (various contrasts), determination of crystal structure, burgers vector, electron beam-specimen interactions and other applications of Transmission Electron Microscopy; Applications of Scanning Electron Microscopy and, Electron Probe Micro-Analyser; Principles of Quantitative Microscopy: Overview of other characterization techniques such as Auger electron spectroscopy, Scanning Tunneling Microscopy, Atomic Force Microscopy.

### **4. Science for Engineers**

Concepts of atomic and molecular energy levels leading to description of plasma state, plasma physics—thermal and non-equilibrium plasma, plasma diagnostics, methods of plasma processing of materials and minerals; Industrial plasmas, new concepts of resource utilization using plasma.

Structure and Bonding; Stereochemistry; Molecular basis of chemical reactions, reaction kinetics, structural effect on reactivity; Micelles and surfactants and their application for bulk processing of mineral resources; Complexation concepts, Molecular engineering; Chemical theories involved in solution, concentration, and purification.

Cell types structure and function; Bio-molecules: composition and bonding; Overview of amino acids, proteins, carbohydrates, nucleic acids, lipids, enzymes, vitamins and minerals; DNA replication; Introduction to bio-mineral processing.

### **5. Recycling of Material Resources**

Mining and metallurgical wastes classification, investigation and evaluation of waste deposits, waste and circulatory management during recycling.

Unit operations involving materials recycling processes such as pre-treatment (physical and chemical), roasting, calcination, sintering, leaching, solid-liquid separation; Solution, concentration and purification techniques—precipitation,

cementation, solvent-extraction, evaporation, crystallization, electrowinning, electroremediation; Resources and recycling technologies across the major materials sectors, and case studies including wastes in steel and aluminium production; Recycling of E-wastes and secondaries; Economic evaluation and project implementation: Flow-sheet development, mass and energy balance, costing, techno-economic feasibility report (TEFR) preparation, financial investment in waste recycling, project planning and implementation, work safety.

## **6. Fundamentals of Engineering Analysis**

Formulation and solution of ordinary and partial differential equations that describe physical systems of importance in engineering; Numerical methods: finite difference, numerical solution of ordinary and partial differential equations.

Fundamental concepts of fluid flow, heat and mass transfer; Shell balance approach for molecular and convective transport processes; Formulation and application of general transfer equations.

## **7. Energy & Environment**

Energy resources and conservation in different metallurgical processes; Renewable energy technologies; Energy audit with case studies.

Important Indian minerals and related environmental issues; Pollutant generation and management; Environmental issues related to mining, processing, and products; Environment impact analysis and management plan; Environmental laws—appraisal and approval; Vulnerability and adaptation technologies for sustainable development; Case studies related to environmental management of minerals and materials industries.

## **8. Advanced Extraction Methods**

Fundamentals of commercially important nonferrous pyrometallurgical extraction processes; Thermodynamics of high-temperature processes and solid-gas reaction kinetics; Heterogeneous kinetics, multi-phase systems, Electrodeposition, Semiconductor electrochemistry; Application: roasting, sulphide-oxide-sulphate systems, oxide-chloride systems, smelting, kinetic analysis, bath smelting,

dynamic contact angle-free energy correlation; Electro-smelting—present practice and future trends; Direct electrowinning, possible electrode systems, conduction types, future trends.

### **9. Process Control & Instrumentation**

Introduction to instrumentation in process industry, Different types of sensors and actuators, Computerized data acquisition, Monitoring and analysis of data (Time series and spectral analysis), Process control, PI Diagram, Introduction to PLC, SCADA & DCS, Networking and communication in industry, Artificial neural network & Fuzzy logic based control, Laboratory work.

## **SUMMER TERM COURSES (COMPULSORY)**

### **10. Research Methodology**

Definition and nature of research, Motivation for research, different types and styles of research in sciences, role of serendipity, scientific temperament, Working of some of the great minds from all walks of life--scientists, artists, writers, etc. Tools for thinking, critical and positive thinking, creativity and innovation, mind mapping; Development of problem solving skills, scaling and orders of magnitude analysis, role of simple models in thinking and in developing an understanding. Scientific and critical reasoning skills, art of reading and understanding scientific papers and critical evaluation of the underlying premises and assumptions, literature reviews. Professional attitudes and goals, concept of excellence, ethics in science and engineering, some famous frauds in science.

### **11. Technical Writing & Communication Skills**

Technical vis-a-vis literary writing, Ethical and legal considerations, Writing process, Collaborative writing, Analyzing audience and purpose, Communicating persuasively, Researching the subject and reference, Organizing information, Drafting definitions and descriptions, coherent text, effective sentences, front and back matter, Designing of documents and familiarization with standard styles, Creating graphics, Writing journal paper, thesis, project proposal, report, technical note, letter, memo, resume, manual, Website design and using software based publishing, Seminar and oral presentations.



## RESEARCH AT IMMT



The Institute of Minerals and Materials Technology (IMMT) at Bhubaneswar, a premier national laboratory of Council of Scientific & Industrial Research, is engaged in R&D on a broad spectrum of issues related to mineral and material resource engineering. It has a sprawling campus of 150 acres full of greenery and quiet ambience, right in the middle of the temple city of Bhubaneswar. It was set up in the year 1964 and occupies a niche position in the country in its core areas of competency.

It aims at meeting the technological challenges of future, in terms of increasing the resource base, processing of low grade and complex ores, extraction of mineral and metal values, energy efficiency, resolution of environmental constraints, waste recycling and disposal, and more importantly the development of advanced materials for various functional requirements in energy, environment and structural applications.

The major R&D departments in IMMT are:

- Mineral Engineering
- Bio-minerals & Biotechnology
- Hydro-&-Electrometallurgy
- Colloids & Materials Chemistry
- Advanced Materials
- Environment & Sustainability

The laboratory is well endowed with an experienced interdisciplinary faculty and world class facilities to impart quality education and research experience. IMMT

carries out a number of research projects funded by mineral and material industries as well as the government in important areas of industrial and national interest.

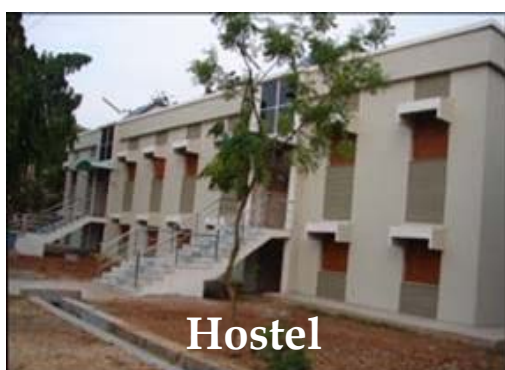
For more details about IMMT's R&D activities, please see the URL <http://www.immt.res.in> .

## FACULTY

<b>Name</b>	<b>Designation</b>	<b>Specialization</b>
Prof. B. K. Mishra	Director, IMMT Bhubaneswar	Simulation and modeling of mineral processing operations, Colloidal systems, Ultrafine particle processing
Dr. RK. Paramguru	Scientist Gr. IV (6)	Thermodynamics & Kinetics of high temperature processes, Electro-metallurgy
Mr. S. K. Mishra	Scientist Gr. IV (5)	Instrumentation & Control
Dr. S. K. Biswal	Scientist Gr. IV (5)	Mineral processing with fine particle treatment
Dr. B. Das	Scientist Gr. IV (6)	Mineral Processing with fine particle treatment with reference to iron ore beneficiation
Mr. P. S. R. Reddy	Scientist Gr. IV (6)	Mineral Processing with particular reference to Column Flotation
Dr. R. K. Dwari	Scientist Gr. IV (1)	Dry Beneficiation, Coal Preparation, Surface Chemistry, Fine particle processing.
Dr. T. Subbaiah	Scientist Gr. IV (6)	Process Development, Pilot Scale Testing, Economic evaluation of commercial plants.
Dr. K. Sanjay	Scientist Gr. IV (4)	Process Engineering, Design & Detailed Engineering of Hydrometallurgical plants, Electroremediation & Computational Fluid Dynamics (CFD).
Dr. B. K. Mohapatra	Scientist Gr. IV (6)	Characterisation of Ores, Geology and Geochemistry

Dr. S. K. Pradhan	Scientist Gr. IV (2)	Thin films, hard/superhard coatings, chemical/physical vapor deposition (CVD/PVD), material characterization by nanoindentation, Raman, AFM, etc.
Dr. B. D. Nayak	Scientist Gr. IV (5)	Solid waste utilization
Dr. P. K. Panda	Scientist Gr. IV (5)	Economic Botany, Environmental Plant Physiology, Designing and Development
Dr. B. P. Bag	Scientist Gr. IV (2)	Supra molecular Photochemistry, Inorganic Chemistry
Dr. B. B. Nayak	Scientist Gr. IV (4)	Materials Science, Plasma Processing of Materials, Thin Films
Dr. Swati Mohanty	Scientist Gr. IV (4)	Process Modelling, Simulation, Optimization and Control
Dr. G. Roy Chaudhury	Scientist Gr. IV (6)	Leaching, Solvent Extraction Cementation, Environmental pollution control
Dr. S. N. Das	Emeritus Scientist	Environmental Chemistry
Dr. Debi Prasad Das	Scientist Gr. IV (1)	Signal processing, active noise control, embedded system, soft computing, Instrumentation

## CAMPUS FACILITIES AT IMMT



IMMT campus is situated in the heart of Bhubaneswar City. Bhubaneswar is a modern planned city conveniently connected to all major locations of India. With several national level academic and R&D institutions, it is fast developing as a knowledge city in the eastern zone.

The campus has adequate facilities for curricular and extra curricular activities. It has a library, computer centre, large auditorium, modern hostels for students, and sports facilities that include a newly laid cricket ground, tennis and indoor badminton court. A newly built canteen offering a good range of food, and a fully equipped hospital for providing medical facilities are located inside the campus.



The campus ambience is certainly going to provide the candidate a wholesome experience of academic activities along with games and other forms of spiritual engagements like yoga, music & cultural events.

**CONTACT FOR MORE INFORMATION:**

**PGRPE Coordinator**

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